Federal Aviation Administration – Regulations and Policies
Aviation Rulemaking Advisory Committee

Occupant Safety Issue Area
Performance Standards Working Group

Task 1 – Emergency Evacuation

Task Assignment

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee; Emergency Evacuation Subcommittee; Performance Standards Working Group

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of establishment of Performance Standards Working Group.

SUMMARY: Notice is given of the establishment of a Performance Standards Working Group by the Emergency Evacuation Subcommittee of the Aviation Rulemaking Advisory Committee. This notice informs the public of the activities of the Emergency Evacuation Subcommittee of the Aviation Rulemaking Advisory Committee.

FOR FURTHER INFORMATION CONTACT: Mr. William J. (Joe) Sullivan, Executive Director, Emergency Evacuation Subcommittee, Aircraft Certification Service (AIR-3), 800 Independence Avenue, SW., Washington, D.C. 20591, Telephone: (202) 267-9554; FAX: (202) 267-9562.

SUPPLEMENTARY INFORMATION: The Federal Aviation Administration (FAA) established an Aviation Rulemaking Advisory Committee (56 FR 2190, January 22, 1991) which held its first meeting on May 23, 1991 (56 FR 20492, May 3, 1991). The Emergency Evacuation Subcommittee was established at that meeting to provide advice and recommendations to the Directors, FAA Aircraft Certification and Flight Standards Services, on regulatory standards for the

purpose of enhancing the ability of passengers to quickly and safely evacuate an aircraft in an emergency. At its first meeting on May 24, 1991 (56 FR 20492, May 3 1991), the subcommittee established the Performance Standards Working Group.

Specifically, the working group's task is the following:

Task: The Performance Standards Working Group is charged with making a recommendation to the Emergency Evacuation Subcommittee concerning whether new or revised standards for emergency evacuation can and should be stated in terms of safety performance rather than as specific design requirements. Specifically, the working group should address the following issues as a minimum:

A. Can standards stated in terms of safety performance replace, supplement, or be an alternative to any or all of the current combination of design and performance standards that now address emergency evacuation found in Federal Aviation Regulations Parts 25 and 121?

B. If a performance standard is recommended, how can the FAA evaluate a minor change to an approved configuration, or a new configuration that differs in either a minor or a major way from an approved configuration?

Reports: The working group will develop any combination of the following as it deems appropriate:

1. A draft notice of proposed rulemaking proposing new standards stated in terms of safety performance with supporting economic

and other required analysis, together with any other collateral documents the working group determines appropriate; or

2. For existing rules where performance standards are not recommended, a report stating the rationale for those recommendations.

3. Recommended organizational structure(s) and time line(s) for completion of this effort, including rationale.

The Performance Standards Working Group will be comprised of experts from those organizations having an interest in the task assigned to it. A working group member need not necessarily be a representative of one of the organizations of the parent Emergency Evacuation Subcommittee or of the full Aviation Rulemaking Advisory Committee. An individual who has expertise in the subject matter and wishes to become a member of the working group should write the person listed under the caption **"FOR FURTHER INFORMATION CONTACT"** expressing that desire and describing his or her interest in the task and the expertise he or she would bring to the working group. The request will be reviewed with the subcommittee chair and working group leader, and the individual advised whether or not the request can be accommodated.

The Secretary of Transportation has determined that the formation and use of the Aviation Rulemaking Advisory Committee and its subcommittees are necessary in the public interest in connection with the performance of duties imposed on the FAA by

law. Meetings of the full committee and any subcommittees will be open to the public except as authorized by section 10(d) of the Federal Advisory Committee Act. Meetings of the Performance Standards Working Group will be not be open to the public, except to the extent that individuals with an interest and expertise are selected to participate. No public announcement of working group meetings will be made.

Issued in Washington, DC, on July 8, 1991.

/s/

William J. Sullivan
Executive Director
Emergency Evacuation Subcommittee
Aviation Rulemaking Advisory Committee

Recommendation Letter

James T. Likes
Director
Payload Systems
Engineering Division

Boeing Commercial Airplane Group
P.O. Box 3707, MS 0R-LA
Seattle, WA 98124-2207

Action: ARM
cc AIR

February 6, 1996

Mr. Anthony J. Broderick
Associate Administrator for Regulations and Certification, (AVR-1)
Department of Transportation
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

(Response to me to work)

BOEING

Dear Mr. Broderick:

I am enclosing a draft copy of a proposed Advisory Circular (AC) on Emergency Evacuation certification. This draft AC is the result of several years of concerted effort to provide guidance that would allow for safer conduct of emergency evacuation tests and give more specific guidance relative to the use of analysis where adequate test data already exists.

This draft is the concluding work on the original task statement to determine if a means could be found to make emergency evacuation tests safer while continuing to ensure that verification of an airplane's evacuation capability is not compromised.

A report titled "Emergency Evacuation Requirements and Compliance Methods That Would Eliminate or Minimize the Potential for Injury to Full Scale Evacuation Demonstration Participants", dated January 1993 was forwarded to you by separate letter. This report was the foundation for the subsequent work and was approved at the June 28, 1993 meeting of the ARAC Emergency Evacuation Issues Area by a vote of 11 in favor, 1 not in favor.

Subsequently, a draft Notice of Proposal Rulemaking titled "Revision of Emergency Evacuation Demonstration Procedures to Improve Participant Safety" was forwarded to your office which would revise certain subparagraphs of FAR 25.803 and 121.291. This draft NPRM was approved unanimously at the Emergency Evacuation Issues meeting of November 18, 1993.

The draft AC being submitted as part of this letter was originally submitted to the Emergency Evacuation Issues Group by the Performance Standards Working Group who had voted in favor of the draft AC except for one abstention: however, the members of the Emergency Evacuation Issues group deadlocked by a vote of 7 to 7 as to whether to submit the draft AC to the FAA. As a result of this vote, I elected to return the draft AC to the PSWG to see if it could be revised sufficiently to obtain full concurrence. That effort led to a meeting of the EEIG in which the

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Performance Standards Working Group again submitted a draft AC with additional revision. The Emergency Evacuation Issues Group again could not reach concurrence. Since numerous meetings by the PSWG had been held in an effort to resolve differences and achieve consensus, I elected to submit this draft AC without having achieved consensus.

In accordance with the ARAC operating procedures relative to consensus, I'm forwarding, in addition to the draft AC, a summary of the opposing viewpoints and the PSWG disposition of these comments.

As Assistant Chairman of the ARAC Emergency Evacuation Issues area, I'm disappointed with our inability to achieve consensus. It is equally disturbing since this draft AC had its origin from a report approved by the EEIG.

I'm forwarding the draft AC to you for consideration in replacing the existing AC since I believe that it provides a substantial improvement to the existing certification guidelines and will enhance our ability to ensure safer emergency evacuations. It is also noteworthy that it has the endorsement from the JAA, Transport Canada and FAA representatives plus representatives from the ATA, AIA, AECMA, RAA and others. As such, we should not lose an opportunity to make a positive gain in improving airplane evacuation for the traveling public.

Sincerely,

James T. Likes
Assistant ARAC Chair
Emergency Evacuation Issues

Enclosures: (2)

cc: Mr. Dan Salvano
Mr. Lew Lebakken

Acknowledgement Letter

U.S. Department
of Transportation

**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

MAR 26 1996

Mr. James T. Likes
Aviation Rulemaking Advisory Committee
Boeing Commercial Airplane Group
P.O. Box 3707, M/S OR-LA
Seattle, WA 98124-2207

Dear Mr. Likes:

Thank you for your February 6 letter forwarding a draft Advisory Circular (AC) on Emergency Evacuation Certification. The draft was developed and recommended by the Performance Standards Working Group of the Aviation Rulemaking Advisory Committee (ARAC), but ARAC could not achieve consensus on it.

I, too, am disappointed that a consensus could not be reached by ARAC; but I am aware of, and appreciate, the significant effort made to do so. Because an agreement was not reached, the Federal Aviation Administration will need to pursue this issue separately. In that effort, we will use the draft you supplied, and the information provided by the dissenters, to determine what changes to the current AC are needed to enhance emergency evacuation participants' safety.

I would like to thank the aviation community, and particularly the Performance Standards Working Group, for its commitment to ARAC and its interest in this matter.

Sincerely,

Anthony J. Broderick
Associate Administrator for
Regulation and Certification

cc: Frank Tiangsing, ANM-114

Recommendation

James T. Likes
Director
Payload Systems
Engineering Division

Boeing Commercial Airplane Group
P.O. Box 3707, MS 0R-LA
Seattle, WA 98124-2207

Action: ARM
cc AIR

February 6, 1996

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Associate Administrator for Regulations and Certification, (AVR-1)
Department of Transportation
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Sincerely,

James T. Likes
Assistant ARAC Chair
Emergency Evacuation Issues

Enclosures: (2)

cc: Mr. Dan Salvano
Mr. Lew Lebakken

EMERGENCY EVACUATION CERTIFICATION ANM-110

25.803-1X
August 1, 1995

1. PURPOSE. This advisory circular (AC) provides guidance on means, but not the only means, of compliance with the Federal Aviation Regulations (FAR)concerning: (1) conduct of full-scale emergency evacuation demonstrations, and (2) use of analysis and tests in lieu of conducting an actual demonstration. Throughout this AC, any reference to an analysis, which is to be used to satisfy the emergency evacuation requirements of the FAR, refers to a formal analysis document supported by data from tests or demonstrations.

2. RELATED FAR SECTIONS.

a. Section 25.803, Emergency evacuation, of 14 CFR part 25 as amended through Amendment 25-79 .

b. Appendix J to part 25 - Emergency Demonstration, as amended through Amendment 25-79.

c. Section 121.291, Demonstration and emergency evacuation procedures, of 14 CFR part 121, as amended through Amendment 121-233 .

3. BACKGROUND.

a. The requirements for emergency evacuation demonstrations were first established in part 121 (§ 121.291) of the FAR by Amendment 121-2, effective March 3, 1965. Operators were required to conduct full-scale evacuation demonstrations with a time limit of two minutes using 50 percent of the exits. The purpose of the demonstration was to validate the crewmembers' ability to execute the established emergency evacuation procedures and to ensure realistic assignment of functions to the crew. A full-scale demonstration was required upon: initial introduction of a type and model of airplane into passenger-carrying operation; an increase in passenger seating capacity of five percent or greater; or, a major change in the cabin interior that would affect emergency evacuation.

b. The requirement for the airplane manufacturer to conduct an evacuation demonstration for airplanes having a seating capacity of more than 44 passengers was established in part 25 (§ 25.803) by Amendment 25-15, effective October 24, 1967. The time limit for the manufacturer's demonstration was established at 90 seconds, and the part 121 time limit was reduced to 90 seconds. It was considered that the manufacturer's demonstration would show the basic capability of a new airplane and, as before, the part 121 demonstration was intended to account for crew training and adequate crew procedures. Therefore, the demonstration conditions were somewhat different.

With the addition of the requirement for a full-scale demonstration in part 25, § 25.803(d) gave conditions for analysis in lieu of demonstration. Section 25.803(d) stated that the demonstration need not be repeated for a change in the interior arrangement or a passenger capacity change of not more than five percent, or both, if it could be substantiated by analysis that the passengers could be evacuated in 90 seconds. At that time, analysis was used for decreases in passenger capacity when an airplane was reduced in size. Generally, the analysis was based on a full-scale demonstration for the larger airplane. Analyses were also used for increases of less than five percent.

c. Since Amendment 25-15, numerous full-scale demonstrations have been conducted by the manufacturers for both type certification and operational requirements. These demonstrations provided data on evacuation rates, escape system performance, and the behavior of evacuees (passengers and crewmembers who evacuate the airplane) during the demonstration.

d. By Amendments 25-46 and 121-149, effective December 1, 1978, § 25.803 was revised to allow a means other than actual demonstration to show the evacuation capability of the airplane and to replace the existing part 25 demonstration conditions with conditions that would satisfy both part 25 and part 121 so one demonstration would serve both requirements. Part 25 was changed to match the conditions in part 121.

Amendment 25-46 removed the five percent limitation on analysis from § 25.803(d). It was proposed in Notice 75-26, that analysis or a combination of analysis and tests be used to show evacuation capability. Amendment 25-46 dropped the provision which allowed analysis alone and required a combination of analysis and tests to assure approvals would be based on sufficient test data. It was considered that sufficient data may not be available in the case of a completely new airplane model or a model which had major changes or a considerably larger passenger capacity than a previously approved model. Thus, the requirement that the Administrator find the data used in the analysis acceptable was intended to preclude approvals which might be based on insufficient test data to support the proposed analysis.

e. Amendment 121-176, effective January 18, 1982, allowed a part 121 certificate holder to use the results of a part 25 demonstration or the part 121 demonstration of another operator to show compliance with § 121.291. This amendment also eliminated the five percent limit from part 121 because the manufacturer would have already shown compliance with § 25.803 and the

partial demonstration required by § 121.291 would show that the carrier's procedures, training program and maintenance program are adequate.

f. The conduct of emergency evacuation demonstrations and the use of analysis in lieu of a full-scale demonstration were discussed at the Public Technical Conference held by the FAA in September 1985, in Seattle, Washington. These items were later discussed in detail at working group meetings. As a result of a paragraph by paragraph review of § 25.803(c), the FAA concluded that it was necessary to formalize policy on conduct of an evacuation demonstration and to clarify items of concern expressed by the group members. Most of the guidance presented in the original version of this AC, and much of the guidance in this revised version, is consolidated from existing FAA policy or the consensus of the working group. In those areas where no consensus could be reached, for example the use of analysis in lieu of full-scale demonstration, the FAA has decided how best to implement the regulations.

g. Amendment 25-72 to part 25 revised § 25.803 by moving the conditions under which an emergency evacuation demonstration was to be run from § 25.803(c) to a new Appendix J to part 25. Additionally, other sections of part 25 were relocated to group requirements more logically. To facilitate the transition to these new locations, the previous section call outs will be included in angle brackets("{}") immediately after the new section call outs.

h. Amendment 25-79 revised Appendix J by revising the age/gender mix to be used when running an emergency evacuation demonstration, by prohibiting flightcrew assistance, and by allowing the use of stands or ramps for descending from overwing exits only when the airplane is not equipped with an off-wing descent means.

i. Amendment 121-233 revised § 121.291 to allow demonstrations in compliance with § 25.803 in effect on or after December 1, 1978, and not just in effect on December 1, 1978, to satisfy the requirements of § 121.291.

j. The FAA established the Aviation Rulemaking Advisory Committee (ARAC) on January 22, 1991, to provide advice and recommendations to the FAA concerning the full range of the FAA's safety-related rulemaking activity. The ARAC, in turn, established a Performance Standards Working Group to study the rules involving emergency evacuation to see if they could be restated in terms of performance standards. A second task was given to the group to recommend revisions to the existing emergency evacuation demonstration requirements and compliance methods to eliminate or minimize injury for participants (persons performing the roles of either passengers or crewmembers in an evacuation demonstration). In January 1993, the working group forwarded a report, "Emergency Evacuation Requirements and Compliance Methods that Would Eliminate or Minimize the Potential for Injury to Full Scale Evacuation Demonstration Participants," to the ARAC. The ARAC accepted the report and forwarded it to the FAA. The recommendations for revising the compliance methods associated with the demonstration have been incorporated into this AC. Additional recommendations involved revisions to Appendix J of part 25. At such time as these recommendations are adopted into Appendix J, additional guidance will be provided as necessary.

4. OBJECTIVE OF THE RULE.

a. A full-scale demonstration is conducted to assess the evacuation capability of the airplane and, when compliance with paragraph g of Appendix J {§ 25.803(c)(7)(i)} regarding compliance with § 121.291 is requested, to also demonstrate the effectiveness of crew training and emergency procedures. Appendix J to part 25 {Section 25.803(c)} specifies the conditions for conduct of the evacuation demonstration.

b. The objective of the analysis allowed by § 25.803(c) {§ 25.803(d)} is to show that the airplane can be evacuated within 90 seconds under the conditions specified in Appendix J {§ 25.803(c)}. The use of analysis can eliminate the running of full-scale demonstrations where adequate knowledge is already available from previous full-scale demonstrations or other smaller-scale tests . A decrease in the number of full-scale demonstrations will reduce the number of participants subjected to possible injury.

5. DETERMINATION OF WHETHER ANALYSIS OR A DEMONSTRATION IS REQUIRED FOR A NEW AIRPLANE TYPE OR A NEW CONFIGURATION OF AN EXISTING AIRPLANE TYPE.

a. Each new airplane type and each change in airplane design of an existing airplane type that may have an effect on the emergency evacuation capability of the airplane should be evaluated for its impact on compliance with § 25.803, either by full-scale demonstration or by a combination of tests and analysis if appropriate.

b. The following are examples of design changes that should be evaluated for their effect on evacuation capability:

(1) A change in type, number or location of exits.

(2) An increase in passenger capacity above that listed on the type certificate data sheet.

(3) Changes in passenger distribution within the cabin area that would increase the number of passengers expected to use an exit pair to a number greater than the exit rating of the exit pair.

(4) Classifying an exit as an "excess" exit in accordance with the requirements of § 25.807(d)(6)(i) {§ 25.807(c)(6)}.

(5) Installation of escape slides or other assist means not previously approved for that model airplane.

(6) Changes to the passenger cabin configuration that reduce the passengers' access to any emergency exit below the access that was provided in the certification demonstration . Examples of such changes include partitions, galleys, etc., that restrict: the flow of passengers merging from

an aisle and cross aisle; the crew's ability to determine which exits are operable; or the crew's ability to balance the passenger flow among the active exits.

c. Testing (component, system, or full-scale) should be conducted when insufficient data exist for an analysis, as discussed in section 7.

d. A decision process for determining whether analysis or a demonstration is required for a new configuration is depicted in Figure 1.

DECISION PROCESS

AS DEFINED IN AC 25.803-1a

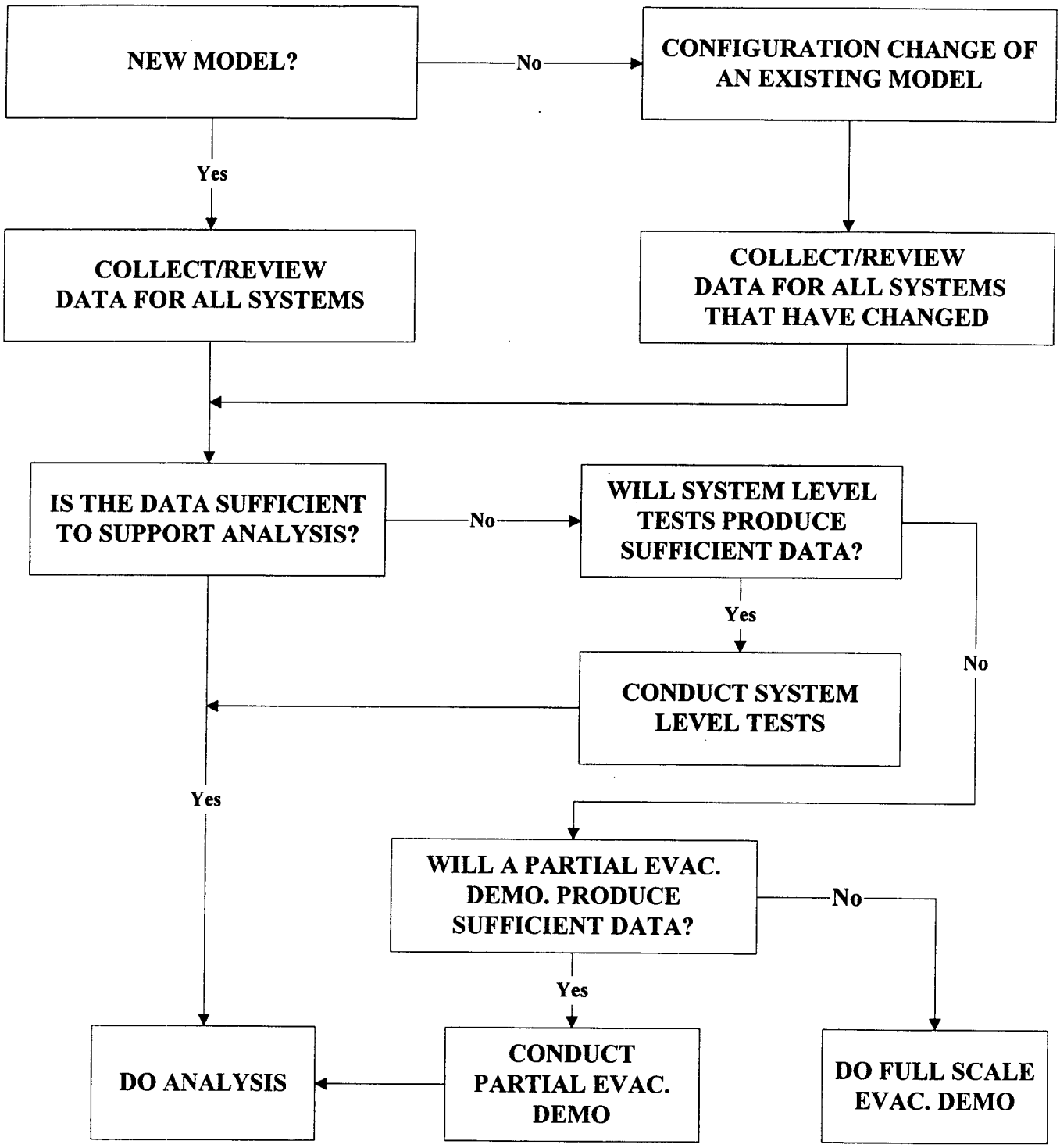

Figure 1

e. The determination whether a demonstration or formal analysis is required is made by the FAA. The applicant can participate in this decision process by preparing a proposal for either running a demonstration or preparing an analysis. If the proposal is to do an analysis, the applicant should indicate the source(s) of the data for the analysis.

6. GUIDANCE FOR DEMONSTRATING COMPLIANCE WITH § 25.803(c) AND APPENDIX J USING AN ACTUAL DEMONSTRATION.

a. Section 25.803(c) and Appendix J. The following is intended to provide uniform standards for conducting demonstrations to make demonstration results as directly comparable as is practical.

(1) Upon determination that an actual demonstration will be required, the applicant should prepare a plan that outlines such details as time and place for the demonstration, demonstration vehicle configuration, and crew training program. This plan should be submitted to the FAA as soon as possible to allow the FAA time to review, request necessary changes, and approve the plan and to arrange for participation of the appropriate FAA organizations.

(2) The phrase "The maximum capacity... for which certification is requested," refers to the airplane model presented for certification.

(3) All passengers and crewmembers used in the demonstration must be evacuated to the ground or to an off-wing ramp (if applicable) within 90 seconds to constitute a successful demonstration. Seats, including restraint systems, adequate for purposes of the demonstration, must be provided for all passengers. (For example, a 5-place seat assembly may be used to seat 6 passengers, if the 6 passengers can be accommodated and 6 restraint systems are installed and used.) The limits of § 25.807(d) or (e) {§ 25.807(c) or (d)} may not be exceeded. Partial credit, equal to or less than the number of evacuees on the ground at 90 seconds, may be granted by the FAA if all passengers and crewmembers used in the demonstration have not been evacuated by that time. For example, if an aircraft is equipped with four pairs of Type A exits, the maximum seating configuration allowed by § 25.807(d) {§ 25.807(c)} provides for 440 passengers. If certification is requested for 440 passengers plus crewmembers, that number of passengers and crewmembers must be provided seating in the airplane and they must evacuate the airplane in 90 seconds for a successful demonstration. If, in the demonstration, only 420 passengers evacuate the airplane within the 90 second time limit, the FAA may allow credit for no more than 420 passengers.

(4) Federal Aviation Administration observers should be stationed inside the airplane at expected critical locations, and outside the airplane at each exit to be used. Airplanes which do not have space for adequate onboard observation should provide interior video coverage to compensate for the absence of official witnesses.

(5) The airplane should be configured with the minimum aisle, crossaisle, and passageway clearances expected to be type certificated. (Configuration changes reducing clearances below

those demonstrated may require substantiation.) This may require combining features of more than one interior configuration. The airplane interior need not be representative of a specific operational configuration for the purposes of the demonstration. For example, galleys and other furnishings may be simulated by mockups; seats need not have a Technical Standard Order (TSO) authorization, etc. The interior configuration should be FAA-approved, as a demonstration configuration, prior to the demonstration, and should be described in sufficient detail to allow a conformity inspection.

(6) The phrase "including the number of crewmembers required by the operating rule" refers to the minimum number of flight crewmembers listed in the Airplane Flight Manual (AFM) and the minimum number of flight attendants required by § 121.391 for the passenger seating capacity to be demonstrated. The observer seats need not be occupied for the demonstration.

(7) If the demonstration fails, the demonstration should not be repeated until the applicant has had time to identify the cause(s) and institute corrective measures. The FAA should be informed of the cause(s) of the failed demonstration and the corrective action(s) taken by the applicant before the demonstration is repeated. Different groups of passengers and crewmembers should be used in repeat demonstrations.

(8) Participants in the demonstration should be encouraged to wear long sleeve shirts, full length pants and low heel shoes in order to reduce the occurrence and severity of injury. If emergency escape slides are used in the demonstration, gloves should be distributed to the participants in order to reduce abrasions to the hands caused by contact with the slide surfaces.

(9) Flight attendants are a critical element in the conduct of a safe, efficient, evacuation. These crew members initiate the evacuation, direct the evacuation process at usable exits, direct passengers away from unusable exits, and provide passenger management within the cabin, all with the safety of the participants as a foremost consideration. Flight attendants should be cautioned about the "demonstration" nature of the evacuation and the importance of minimizing the potential for injury by using passenger management techniques which are consistent with airline training programs.

(10) Thorough internal and external video/movie documentation may be beneficial for acquiring data, explaining anomalies, or identifying causes of failed demonstrations.

(11) A test abort signal system is recommended.

b. Paragraph c of Appendix J {Section 25.803(c)(3)}.

(1) If the airplane is equipped with an off-wing assist means, it should be used during the demonstration in lieu of stands or ramps.

(2) Safety personnel stationed outside the airplane to help in preventing injury, should not position any assist means (e.g., slides or ramps) following its deployment or otherwise interfere or assist in the evacuation process except as necessary to prevent injury to a participant.

[Note: The FAA may assess time penalties (i.e., add to the total evacuation time at any specific exit) if it is determined that the intervention by safety personnel significantly accelerated completion of the demonstration.]

(3) Safety personnel stationed on the wing of an airplane equipped with removable exit hatches may accept the hatches if they are passed out of the exit opening. The hatches must be at least halfway out of the airplane before the safety personnel may assist. The safety personnel may not encourage, by word or gesture, the person in the cabin to hand the exit hatch to them.

c. Paragraph e of Appendix J {Section 25.803(c)(5)}. The emergency descent devices used in the demonstration should be those intended to be in the airplane type design. If the descent device is a slide, the slide certification program should have progressed to the point where the system is reliable and can be expected to perform safely during the demonstration.

d. Paragraph g of Appendix J {Section 25.803(c)(7)}.

(1) Evacuation demonstrations conducted to meet the requirements of § 25.803(c) only, i.e., to demonstrate the evacuation capability of the airplane, need not use regularly scheduled crewmembers (see sub-paragraph 6.e. for a definition of regularly scheduled crewmembers). Therefore, there are no crew training requirements specific to the operating rules, i.e. part 121, for the demonstration.

[Note: Airplanes which have been shown to meet § 25.803(c) only, may need to have a full-scale emergency evacuation demonstration conducted which satisfies § 121.291 before being allowed into part 121 operations.]

(2) Evacuation demonstrations intended to meet the requirements of § 25.803(c) and § 121.291(a)(1) should use regularly scheduled line crewmembers. These demonstrations are conducted to demonstrate the evacuation capability of the airplane and to demonstrate the effectiveness of the crewmembers' emergency training program and evacuation procedures.

[Note: These procedures, successfully demonstrated, should not be revised in service without due consideration of the possible impact on the emergency evacuation capability of the airplane.]

(3) Flight attendants should be seated at cabin locations consistent with § 121.391 at the start of the demonstration.

(4) The normal demonstration start signal is the interruption of ground power to the airplane, as evidenced by the extinguishing of normal cabin lighting.

(5) Following the demonstration start signal, the flight crew should delay evacuating the flight deck by a time equivalent to that required to accomplish appropriate emergency operating procedures.

(6) Crewmembers in excess of the number required for the demonstration should be available so that the FAA can select the crew that will participate in the demonstration. Crewmembers that are not selected may be considered by the FAA for participation in any subsequent demonstrations that may be conducted.

e. Paragraph g of Appendix J {Section 25.803(c)(7)(i)}. In order to be considered a "regularly scheduled line crew," the crew should meet the following requirements:

(1) The crew should be trained in specific duties related to an emergency evacuation in accordance with an FAA-approved training program (for evacuation demonstration purposes). This training program need not be a complete flight attendant training program but should be an emergency evacuation training program similar in content and duration to the emergency evacuation portion of training programs approved under part 121 . Reference paragraph r of Appendix J {§ 25.803(c)(19)}.

(2) If the crew to be used for the demonstration has been previously trained under an operator's FAA-approved program, additional training may be given when the airplane model or layout to be demonstrated differs from the one used by that operator. Training in exit operation and passenger management is especially important for a demonstration of a new model airplane. This training should be similar in content and duration to the training received by a flight attendant when an operator adds a new model airplane to their operating certificate. The crew should not be trained for specific demonstration conditions, except that specific training should be given which relates to the safety of the participants prior to and during the demonstration. This specific safety training should relate to initiating and recognizing the signal for emergency termination of the demonstration and emergencies related to the demonstration site. The FAA should be provided with documentation describing all special training that was given in preparation for the demonstration.

(3) If the demonstration is not successful and flight attendant procedures are changed in order to successfully conduct a repeat demonstration, the changes in procedures should be fully documented and added to the training program.

(4) The training required for a successful demonstration should be the basis for the training program of all operators utilizing the demonstration for compliance with § 121.291(a)(1).

(5) The crew to be used in the demonstration should participate as required crewmembers on a regular basis and should not be instructors, supervisory personnel, safety representatives from worker organizations, or anyone else who may be expected to have knowledge of evacuation demonstrations beyond that of an average crewmember.

(6) Crewmembers from more than one operator may be used in the demonstration.

f. Paragraph h of Appendix J {Section 25 803(c)(8)}. The term "normal health" means that participants should be free of medical conditions or physical limitations that could affect the demonstration results or increase the chance of injury to themselves or others.

g. Paragraph h of Appendix J {Section 25.803(c)(8)}. The following two age and sex distributions have been found to be acceptable to the FAA in lieu of the distribution stipulated in paragraph h of Appendix J (§ 25.803(c)(8). (In both groups, results which include a fraction should be rounded up to the next whole number.)

Age and Sex	Percent of Total Passengers
Group 1:	
21-50	Not to exceed 80%
51-59	At least 15%
60+	At least 5%
Any age female	At least 32%
51-59 female	At least 6%
60+ female	At least 1.5%
Group 2:	
18-50	Not to exceed 75%
51-60	At least 25%
Any age female	At least 32.5%
51-60 female	At least 10%

h. Paragraph h(4) of Appendix J {Section 25.803(c)(8)(iv)}. The life size dolls should be of appropriate size and weight to simulate an infant two years old or younger.

i. Paragraph h(5) of Appendix J {Section 25.803(c)(8)(v)}. In addition to those persons prohibited by the regulation, persons involved in the design or type certification of escape systems, development of emergency evacuation crew training, or those who have previously conducted evacuation demonstrations should not be used as passengers for the demonstration.

j. Paragraph i of Appendix J {Section 25.803(c)(9)}. Passenger seating for the demonstration should be random. One method for ensuring this is for passengers to be allowed to select their own seats. Employees of the applicant may not be allowed to sit next to exits unless they have no specific knowledge which would affect the outcome of the demonstration. Federal Aviation Administration observers may, at their discretion, reseat passengers.

k. Paragraph k of Appendix J {Section 25.803(c)(11)}. Simulated carry-on luggage in the form of small suitcases, gym bags, airplane flight bags, briefcases, etc., filled with clothes or newspaper, that will fit under a passenger seat should be placed in the main aisle(s) with

approximately one bag per seat row for each aisle. Also, some bags should be placed in the cross aisles and passageways, and pillows and blankets should be scattered in the main aisle(s).

l. Paragraph l of Appendix J {Section 25.803(c)(13}.

(1) Neither the crew nor passengers should hear or otherwise receive any indication that the demonstration is about to begin. The first indication to participants should be the extinguishing of the normal cabin lighting.

(2) If safety devices or any other equipment external to the airplane could indicate which exits are to be used in the demonstration, passengers and crew should enter the airplane through a tunnel or other means that will prevent them from seeing that indication.

(3) Placement of video cameras inside the airplane should not indicate which exits are to be used in the demonstration. This may require installation of cameras at all exits.

(4) Mechanical methods of exit deactivation which are not perceptible to crew or passengers prior to attempting to operate the exit should be used. If exit deactivation is indicated by a visible signal (e.g., by a red light outside the exit) the indication should not be visible from inside the airplane until after the demonstration has begun.

(5) If one or more of the exits must be mechanically deactivated after the airplane has been boarded, care should be taken to prevent the crew from becoming aware of the deactivation by sounds or other indications.

(6) For those airplanes equipped with emergency descent means, the means should be installed at inactive exits as well as active exits if the airplane is normally equipped with them.

m. Paragraph m of Appendix J {Section 25.803(c)(14)}. The following are guidelines for the applicant to obtain informed consent from participants in the demonstration and still comply with the intent of paragraph m of Appendix J {§ 25.803(c)(14)}. These guidelines are not intended to be a complete list or meet specific legal requirements. The applicant is responsible for obtaining informed consent and for complying with all applicable local, state and federal laws and regulations regarding the protection of humans employed in demonstrations of this nature.

(1) The applicant should seek consent under circumstances that provide the prospective participants sufficient opportunity to freely consider whether or not to participate in the demonstration. Coercion or undue influence to participate in the demonstration is not permitted.

(2) The prospective participants should be informed of the purpose of the demonstration and the expected duration of their participation. They should also be given a description of any logistical procedures to be followed before and after the demonstration. Details of the demonstration parameters, e.g., time limits , active exit percentages, etc. should not be disclosed, but the approximate number of participants in the demonstration may be revealed.

(3) The prospective participants should be given a description of any reasonably foreseeable risks or discomforts which may be encountered in the demonstration, such as the type or probability of injury when using an escape slide. Participants may also be informed of any techniques and/or equipment that will be used to limit the discomfort or injury such as protective clothing, emergency abort procedures for the demonstration, pads around the slides, availability of restrooms, etc.

(4) Prospective participants should be informed of any direct benefits to them (e.g., pay, meals, etc.) and of benefits to society (e.g., improved safety by demonstrating the emergency evacuation capability of the airplane) that would result from their participation.

(5) Prospective participants should also be informed of any compensation and/or medical treatments that will be available if injury should occur. They should also be informed of the procedure for acquiring these services, and where further information may be obtained.

(6) Prospective participants should be informed that participation is voluntary, that refusal to participate will involve no penalty, and that a participant may discontinue participation at any time prior to the beginning of the demonstration without penalty or loss of benefits to which the participant is otherwise entitled.

(7) Prospective participants should be informed of the consequences of a decision to withdraw from the demonstration at any given time and the procedures for orderly termination of participation. This explanation should include the consequences of attempting to withdraw after the demonstration has started, e.g., the possibility of being pushed out of the airplane if the participant stops at the exit.

(8) The prospective participants should be given the opportunity to ask questions, and be provided information on whom to contact for answers to future questions and how to withdraw from the demonstration.

(9) After participants have been fully informed, they should provide written informed consent to express their understanding and willingness to participate.

n. Paragraph n of Appendix J {Section 25.803(c)(15)} The passengers may be told that they are evacuating an airplane via the escape slides, if applicable, and to follow the instructions of the crew, but a description of the location or operation of the exits, the conduct of the demonstration, or additional information not in the passenger briefings required by §§ 121.333(f), 121.571(a), 121.573 (a), (c) and (d), and 121.585(h) and (i) should not be given. Passengers, seated within and including 3 rows of any exit may not have the benefit of prior practice in exit or escape system operation or knowledge of the demonstration airplane configuration, since passengers are not expected to be trained.

o. Paragraph p of Appendix J {Section 25.803(c)(17)}. In order for the active exits to be representative of all of the required emergency exits on the airplane, one exit from each pair should be used. Flightcrew exits, ventral exits, tail-cone exits, and exits in the side of the fuselage that are not part of a pair should not be used for the demonstration (even if additional passenger capacity has been granted), except for ventral and tail-cone exits used in conjunction with an exit on the side that has been determined to be equivalent to an exit pair, such as the aft exits on the MD-81 and 82. (The MD-81 and MD-82 have a tail-cone exit and a Type I exit which is located on the left-hand side of the fuselage, aft of the wing. The FAA has determined that these two exits form an exit pair.)

p. Paragraph s of Appendix J {Section 25.803(c)(20)}.

(1) The restriction on the acceptance rate of the stand or ramp is considered to be met, if the width of the stand or ramp is not greater than the width of the escape route required by § 25.810(c).

(2) The demonstration is complete when the last evacuee (passenger or crew) has cleared the assist means and has both feet on the ground or ramp (if provided at the off-wing exit). Typically, the entry to the ramp is coincident with the area on the wing where evacuees, led by required markings on the wing, would slide or jump to the ground.

7. GUIDANCE FOR DEMONSTRATING COMPLIANCE WITH § 25.803(c) {§ 25.803(d)} USING A COMBINATION OF ANALYSIS AND TESTING

a. Regulatory Background.

(1) The preamble to Amendment 25-46 makes it clear that adequate test data are a prerequisite for using analysis instead of conducting a full-scale emergency evacuation demonstration to substantiate airplane evacuation capability. It is intended that the analysis be a conservative prediction of the results that would be achieved if a full-scale demonstration were conducted. As such, the assumptions used should be conservative, e.g., using average evacuee flow rates through exits rather than the best flow rate achieved in previous demonstrations.

(2) Full-scale demonstrations should be required when the effects on evacuation performance of configuration changes identified in paragraph 5.b. cannot be substantiated by component and/or system test and analysis.

b. Technical Basis for the Analytical Approach.

(1) The analytical approach for substantiation of evacuation system capability should be based on available performance data from formal tests. Documentation of the analysis should establish credibility by identifying elements of the evacuation system, (e.g., features of the interior arrangement, door sizes, egress assist means, and relative door locations), citing applicable tests of record involving similar or identical elements, and then applying the recorded, verifiable

performance data to the new configuration in a valid manner. Additionally, data from unsuccessful full-scale demonstrations should be carefully scrutinized before being used, to ensure that the failure has not biased the data.

(2) Graphical representations and a detailed description of the airplane interior configuration emphasizing the emergency evacuation provisions are essential and are required for database development. A detailed configuration description should lead into and justify the use of the certification demonstrations and any other tests that are included in the database.

(3) The certification basis that applies to the specific model in question and those of other models that will be used, should be clearly stated in the analysis. The resulting implications should be thoroughly reviewed and discussed.

(4) Any special condition, exemption, or equivalent safety finding that applies to the evacuation systems of the subject configuration, or any configuration for which data will be presented, should be discussed and referenced or included as an appendix to the analysis document.

c. The Airplane Configuration.

(1) The configuration should be described in detail. If the configuration is a derivative of an existing, previously certified configuration, the primary differences should be clearly stated in terms of passenger capacity and evacuation capability.

(2) Features of the passenger cabin interior arrangement and evacuation system (such as aisles and cross-aisles, exit passageways, attendant assist spaces, doors and emergency hatches, etc.) significant to the analysis should be presented in the form of diagrams or formally controlled drawings in an appropriate scale. Those features that require special attention in the analysis may warrant use of supplemental drawings or diagrams.

(3) The cabin arrangement and evacuation system components should be depicted and described in enough detail to establish a useful historical record. Such descriptions should include, as applicable, the location, operation, and dimensions of the cabin and its features that are significant to evacuation:

- seats (passenger and flight attendant)
- aisles and passageways
- exits
- emergency egress assist means
- flight attendant assist spaces
- monuments, including the aspect of visual obstruction
- safety equipment
- lighted signs and emergency lighting
- any other cabin characteristics affecting evacuation

(4) Features of the airplane exterior which affect evacuation (such as engines and wing flaps) should be described in detail. Exterior features and the evacuation system they affect should be presented in the form of diagrams or formally controlled drawings in an appropriate scale.

d. Similar Features in Previously Demonstrated Airplanes. Where the configuration is a derivative model of a configuration certified by a full-scale demonstration, common features need to be clearly identified and discussed. Typically, some door and assist-to-ground systems are likely to remain unchanged or very similar in derivative models evolved from a baseline configuration. Interior features may be unchanged within complete or major parts of cabin zones.

e. Unique Features of the Configuration.

(1) Comparative drawings should be used to focus attention on configuration differences as well as similarities. The features that are unique to the configuration should receive a great deal of attention. If, for instance, a new door system is to be installed in a production model derivative, the effects of this change should be documented. Data from "similar" door systems demonstrated in other airplane models are obvious sources. To use these data, a strong case for "similarity" must exist and be developed in the analysis. For example, dimensional parameters of the unique features should match those of the demonstrated, certificated systems. Performance data from those systems would then be included in the analysis to ensure the new configuration meets the regulations.

(2) When a new installation changes some specific features of an earlier installation and, therefore, changes system performance, the change should be substantiated. Performance data from both the earlier installation and the new installation should be provided in the analysis.

(3) If evacuation system certification data (from a test conducted by the applicant and witnessed by FAA personnel) with apparent relevance to the subject configuration has been purposely excluded from the analysis, the reason(s) for excluding these data should be documented.

f. Flight Attendant Requirements. The required minimum number of flight attendants is established by § 121.391(a). As stated in § 121.391(b), when the number of flight attendants used during a full-scale airplane evacuation demonstration for certification exceeds the minimum number stipulated by regulation, the number of flight attendants in excess of the minimum number required in § 121.391(a) must be added to the number of flight attendants required by § 121.391(a) for any seating capacity. The required number of flight attendants and their seating provisions should be indicated on an appropriate configuration diagram.

g. Interior Configuration Overview. A discussion of how the subject configuration satisfies the intent of §§ 25.807 and 25.813 is an important part of the evacuation capability analysis and should receive appropriate emphasis. These sections define the various passenger emergency exit

types, stipulate the required number and types of exits necessary to accommodate passenger seating capacities, and set forth requirements for accessibility and location of exits. The analysis should directly address the issue of passenger distribution and exit capability distribution within the cabin. When physical constraints, e.g., body structure, wing and engine location, prevent appropriate geometrical uniformity of exit placement, compensating factors that enhance evacuation capability should be discussed.

h. Exit Distribution Uniformity. The geometric distribution of the exits, rated capacities of the exit types provided, and seating densities of the various cabin zones should be documented. The geometric distribution of exit openings is obvious when depicted to scale on a drawing. Uniform distribution of the exits relative to passenger distribution may not be immediately obvious. One means for addressing adequate exit distribution uniformity, taking passenger distribution into account, is provided in Advisory Circular 25.807-1, Uniform Distribution of Exits.

i. Historical Data Foundation for the Analysis. Analysis to determine evacuation capability depend on the existence of applicable demonstration or test data that are formally recorded and verifiable. Applicability and validity are governed by evacuation system component similarity and conditions of test conduct. Conditions called out in Appendix J to part 25 and § 121.291 are the best qualifiers for screening existing evacuation performance data to be applied to the subject configuration. All such data should be addressed in the analysis. Results from partial evacuation demonstrations and developmental or qualification tests should be used to fill data gaps where no full-scale evacuation demonstration precedents can be cited for elements of the subject configuration; these partial demonstrations or tests should be shown to have been run under appropriate conditions.

j. Applicable Previous Full Scale Demonstrations. The full-scale certification demonstrations that are offered in support of the analysis need to be identified and described. Include the date and location of the demonstration, the airplane model involved, the passenger and crew complements, and the regulation upon which the demonstration was based (part 25 and/or part 121). The description should address the elements of paragraphs 7.c and 7.f. If applicability is not obviously indicated by the airplane model, the reason for including the demonstration should be clearly stated.

k. Applicable Subsystem Developmental, Qualification and Certification Tests.

(1) Tests other than full-scale emergency evacuation demonstrations that are included as data sources for the analysis, should be specifically identified and discussed. Reasons for their inclusion should be clearly stated. As an example, deployment/inflation time data for a new slide or slide/raft could be introduced and substituted into an evacuation event sequence (time line) for a system that is otherwise identical. This would be acceptable because slide or slide/raft deployment and inflation, once initiated, is independent of further human intervention and insensitive to the test conditions of Appendix J .

(2) Similarly, Latin Square testing (see Appendix 4 of Advisory Circular 25-17, Transport Airplane Cabin Interiors Crashworthiness Handbook) can be used to compare the performance capability of a new escape system or systems component against the known capability of an existing system or component.

(3) Additionally, a test method referred to as a "platform" test has been used to assess the crew's ability to manage flow of passengers for a given interior configuration. In that test, evacuees exited onto platforms positioned at the sill heights of the floor level exits rather than onto escape slides. Due to the limited prior use of this test method, appropriate test conditions and pass/fail criteria need to be established for each new situation.

(4) The formal test reports and supplemental record (movie film or video tape) of subsystem testing should be referenced in the analysis and available for FAA review.

l. Elements of Time Required for Evacuation.

(1) A formula suited to the evacuation capability analysis task and accepted as credible and correct by the FAA has been established. It is based on an escape system time line or sequence of events that can be readily observed in film or video tape coverage of full-scale evacuation demonstrations.

(2) The total evacuation time through a given exit can be defined by the following expression:

$$T_{Total} = T_{Exit\ Prep} + T_{Exit\ Flow}$$

where:

T_{Total} = Total evacuation time for the exit, equal to the time interval from demonstration initiation until the last evacuee arrives on the ground or on a stand at an overwing exit as allowed by paragraph c of Appendix J.

$T_{Exit\ Prep}$ = Time for exit preparation, equal to the time interval from demonstration initiation until the first evacuee arrives on the ground or on a stand at an overwing exit, including:

- -- flight attendant or passenger reaction time, as appropriate,
- -- exit opening,
- -- descent device deployment, and inflation to the point of being usable (if applicable),
- -- first evacuee hesitation time (defined as the elapsed time between when the device becomes ready for use and when definite contact with the device, with motion toward the ground, has been achieved by the first evacuee), and
- -- time for initial evacuee to traverse to the ground (using the descent device, if applicable), or on a stand at an overwing exit.

$T_{Exit\ Flow}$ = Time of exit flow, equal to the time interval from first evacuee on the ground or on a stand at an overwing exit to last evacuee on the ground or on a stand at an overwing exit.

m. Database to Support the Analysis.

(1) Pertinent data values from the tests and demonstrations discussed in paragraphs 7.k and 7.l should be organized into a "database" for the analysis. The database should identify the source of each data point to the degree necessary for independent verification. For evacuation system certification demonstrations, the identifying parameters should include (as a minimum):

- airplane model (and operator, if applicable)
- date of demonstration
- governing regulations, i.e., part 25 or part 121
- exit identification

(2) When the data value used in the analysis is an interval of time between two observed events, the event times, in addition to the time intervals, should be included in the "database." The events are observable and can be verified directly, whereas the intervals are derived from the event times. A single tabulation of all events necessary to support the analysis provides a centralized "database" and is more amenable to verification and understanding.

(3) In the event a dataset contains an unusual event affecting interval time, such as an evacuee jumping out prior to full inflation of the descent device, or descent devices deflating during the demonstration, those data should be adjusted as appropriate. Such adjustments should be documented.

(4) When data values from multiple tests or demonstrations are available, average performance is used in the analysis. Flow rate data are transformed to time intervals per evacuee by taking the reciprocal, then the intervals are averaged to yield the average interval per evacuee.

n. Data Presentation (Organization). Several event times in the database may need to be processed to yield the numerical values for evaluating the evacuation time of the subject configuration. Organizing the respective database values according to time element of the evacuation process provides a convenient means to show the data and the process. The data presentation section of an analysis should contain a subsection for each time element of the evacuation time line that requires reduction or processing of database event data, e.g. Table 1.

Table 1

DATABASE PRESENTATION EXAMPLE

757-200 CERTIFICATION DEMONSTRATION DATA

	Door 1L	Door 2L	Door 4L
Exit Prep. Time (sec.)	8.1	11.8	10.0
Flow rate (epm)	70.8	68.7	52.0
Time per evacuee (sec.)	.847	.873	1.154

epm = evacuees per minute

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o. Time for Exit Preparation.

(1) The time for exit preparation needs to be determined. If part of an exit system has been upgraded or otherwise changed since the full-scale evacuation demonstration(s), it may be necessary to revise the exit preparation time from that observed in previous demonstrations to use in the analysis. $T_{Exit\ Prep}$ can be determined by timed tests of the new system or by summing the separate elements of $T_{Exit\ Prep.}$ Any adjustment should be fully documented.

(2) Exit preparation includes opening the exit and deploying any installed assist device. If the external assist device is an inflatable slide or slide/raft, the device is considered deployed when it exhibits the rigidity necessary to safely sustain a load (stable and fully extended) although it may not necessarily be touching the ground. When the subject configuration includes the same basic exit system as formerly demonstrated, a straightforward tabulation of values applicable to that exit system should be presented. The average(s) should be shown and identified accordingly.

(3) "Hesitation time" may be defined as the interval of time when the assist means (if required, usually a slide) is ready for use and the egress of the first evacuee. It may simply be the time necessary for the first evacuee to respond to the flight attendant's command, or it may include a reluctance to jump. The analysis should account for hesitation by measuring the time that elapses when the slide is perceived as inflated and fully extended (though not necessarily on the ground) until the first evacuee starts descent on the slide. A suitable hesitation time may be derived by averaging all hesitation data values.

(4) Some off-wing escape systems may prompt a modification to the analysis technique to properly account for first evacuee hesitation. Overwing door opening or hatch removal may trigger a slightly delayed deployment and inflation of the off-wing inflatable. The first evacuee could emerge through the exit to the wing or wing ramp surface in advance of the off-wing slide

being ready for use. Depending on available data, the evacuation capability analysis for some such systems should be based on first evacuee on the ground.

(5) After accounting for hesitation and doorway egress, the time for the first evacuee to travel from the point of contact with the slide or overwing ramp to the ground must be added to the time line. Average values, if used, should be noted. The descent device traverse time should include the on slide and on ground event times from which the traverse time interval is derived.

p. Time for Exit Flow.

(1) The period of evacuee flow through an exit system, $T_{Exit\ Flow}$, depends on flow rate and number of evacuees. Flow rates used in the analysis are those established by earlier demonstrations and tests and converted to intervals as described in paragraph 7.m.4. $T_{Exit\ Flow}$ is then derived by multiplying the number of evacuees allocated to the exit minus one (n-1) by the average interval established for each evacuee.

(2) A dependable and accurate technique to determine flow rate from film or video tape is to: (a) select a stable point or plane of reference in the flow path field of view; (b) record the event times for passage of first and last evacuees, thus determining the time of flow; and (c) calculate the flow rate (in evacuees per unit of time) by dividing the count of evacuees minus one by the flow time. The flow time starts with the first evacuee at the reference point. The remaining evacuees pass the reference point during the flow period. One evacuee, therefore, is subtracted from the total evacuee count to determine flow rate when a fixed-point or plane of reference technique is used.

q. Evacuee Allocation to Exits. The allocation of evacuees to exits should be established and illustrated on a configuration drawing. The allocation should be consistent with the demonstrated capability of the same or similar exit systems and with the distribution of exits and passenger seating relative to the exits. The illustration should convey the substance of an emergency evacuation plan that flight attendants, and flight deck personnel (for certain part 25 applications only) work to achieve with the subject configuration. The goal of the plan is to get everyone out as soon as possible. Passenger management techniques employed in the analysis need to be substantiated by records of earlier demonstrations and/or tests.

r. Flight Crew and Flight Attendant Duties. The crew members' positions during takeoff and landing and their primary and secondary duty stations during an emergency should be indicated on a suitable configuration diagram. Their duties should be described in the analysis. Demonstration or test data should be cited that substantiates the ability of crew members to travel to their duty stations. Procedures which would require a flight attendant to bypass an exit (other than one in the immediate vicinity of the flight attendant's seat) to get to his/her primary or secondary duty station should not be proposed.

[Note: Flight crew participation is limited to certain part 25 applications only.]

s. Passenger Management The definition of "passenger management" for purposes of this advisory circular is the directing of passengers to active exits by flight attendants after initiation of the evacuation. The goal of passenger management is to minimize the total time for evacuation while ensuring passenger safety.

To address passenger management, the applicant should show that similar flight attendant duties (see paragraph 7.r), allocation of evacuees to exits (see paragraph 7.q), and cabin configuration (see paragraph 7.c) have resulted in a successful full-scale evacuation demonstration(s) or equivalent test(s).

[Note 1: Bypass of an active exit, when included in the analysis, should be based on bypass accomplished during a full-scale demonstration.]

[Note 2: When exit systems are not symmetrically located or different performance characteristics have been identified for cross cabin exits, the analysis should address the most critical exit of each exit pair.]

t. Total Evacuation Time Calculations.

(1) Utilizing the data, formula, and analytical techniques described above, the total evacuation time per exit as described in paragraph 7.l can be determined for the configuration.

(2) A configuration diagram, annotated with the calculated evacuation times and evacuee counts near the exits used can be used to provide a graphic summary of results. A single configuration diagram could satisfy the multiple purposes of depicting exits used, passenger and crew allocation to exits (cabin division lines) and the resulting evacuation times per exit.

u. Success Criteria.

(1) If the results of the total evacuation time calculations are less than 90 seconds, the analysis has shown that the airplane can be evacuated under the demonstration conditions established by Appendix J of part 25 or section a to Appendix D of part 121, within the time criterion contained in § 25.803(c) and § 121.291(a), respectively.

(2) The applicant should then prepare an evaluation of the additional evacuation capability (time margin) of each exit that was used in the analysis.

(a) The following formula may be used to determine the available time margin for the airplane configuration being reviewed:

$$\text{Time margin} = \Sigma_{i=1}^{n} (90 - T_{\text{Total Exit } i})$$

where:

$T_{\text{Total Exit } i}$ = Total evacuation time for the exit

n = Total number of exits used

The available time margin calculated using the above formula should be 9 or more seconds. The time interval of 9 seconds (10% of the current standard of 90 seconds) was based on the demonstrated capability of today's transport category aircraft.

(b) An alternative to the margin calculations shown above, as a means of showing conservatism in the analysis, would be to use exit flow rates less than the calculated average and exit preparation times greater than the calculated average. The amount of performance degradation can be a calculated number such as the value of a standard deviation. The average evacuee flow rate would be reduced (thereby increasing the time of exit flow) and the average exit preparation time would be increased by the respective calculated values. If, however, the data used to derive the standard deviations is widely scattered resulting in a large value for the standard deviation, the applicant may choose to use the slowest rate or longest exit preparation time instead.

v. Initial Coordination of Analysis. As a general guideline, evacuation analyses should be informally coordinated as early as possible with the FAA certificating office prior to formal submittal to ensure that all significant factors have been addressed.

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Manager, Transport Airplane Directorate
Aircraft Certification Service

F:\HOME\FT\AC\25-803XR.DOC
4/14/93:
5/17/93:
5/19/93: (based on writing team meeting 5/18-19/93)
7/9/93: (based on writing team meeting 7/7-8/93, converted to standard format without bold/italics or strikeouts, also took part 6 and made it into 6 and 7 and added headings to paragraphs in 7)
7/12/93: minor change to pages 7 and 8 (age/sex mixes)
7/19-20/93: revised per comments from Stacho/Kuttler/Young/Rees/Gardlin
8/9/93: revised per comments from PSWG mtg no. 14 - other changes still to come - due at writing group meeting 9/20/93- added bold and [] for identification of changes.
9/22/93: revised per writing team meeting 9/20/93 and PSWG mtg 9/21-22/93
[originally done in Word Perfect, converted to Word 3/10/94]
5/16/94: revised per writing team meeting 5/10-11/94 in Long Beach (note 25.803X4.DOC is the version with revision marks, 25.803X5.DOC is the version with the revision marks deleted and all the Parts changed to parts except at the start of sentences plus a few changes done on 5/17)
6/8/94 Changes from 5/25-26/94 meeting
6/15/94 Franks revisions to 6/8/94 version
7/15/94 Incorporates Meg Leith's editorial changes
7/18/94 Franks edits
7/29/94 Revisions per PSWG mtg on 7/26-27/94 (xJ is mark-up with revision lines, xK is clean version)
8/10/94 (Revision per FT edits, changes only saved in xk.doc)
9/14/94 Revised to standardize usage of "passenger," "participant," and "evacuee." Also added definitions for participant and evacuee in the body of the text. 25-803XL.DOC has revision lines included. 25-803.XM does not have revision lines.
9/23/94 Revision 25.803XN reflects the changes accepted at the PSWG meeting of 9/20-21/94 basically from FAA Directorate comments. This revision includes revision lines.
9/23/94 Revision 25.803XO is the same as 25.803XN except the revision lines are deleted. Note that this includes a small revision to k(6) on page 12 per Doug Anderson, done on 10/3/94.
11/3/94 Revision 25.803XP per changes from ACTT mtg of 11/3/94 with revision marks.
11/9/94 Revision 25.803XQ per changes from the ACTT mtg of 11/3/94 without the revision marks.
5/23/95 Revision 25.803XR per changes from meeting between the ACTT and the EEIG "Group of 7" in D.C. May 17-18, 1995 - this version includes the revision marks.
6/12/95 Revision 25.803XS per changes from the 6/6-8/95 PSWG meeting in Paris - revised 6.b.2 after discussions with ANM-7.
7/31/95 Revision 25.803XT is the "S" version without revisions.
8/1/95 Revision 25.803XU is the mark-up per the 7/25-27/95 PSWG meeting in D.C.
8/1/95 Revision 25.803XV is the same as XU except no revision marks

PERFORMANCE STANDARDS WORKING GROUP RESPONSES TO COMMENTS FROM ORGANIZATIONS OPPOSED TO THE DRAFT REVISION TO ADVISORY CIRCULAR (AC) 25.803-1

Note: The team preparing these responses determined that the most expeditious manner to respond was to ascertain the essence of the objections the commenter had against the draft AC revision and to respond accordingly. Comments which were not relevant to the discussion of what should or should not be included in the AC and why, were not considered.

AFA:

COMMENT: "Our primary concern is with the validity of the basic assumption upon which the analytical procedure in the draft AC is based, i.e., that any airplane cabin configured so that each of the 'minimum' evacuation-related requirements of the FARs, considered individually, is met or exceeded will have satisfactory emergency evacuation performance and therefore does not require a full scale evacuation demonstration... The proposed analytical method also fails because the variables of passenger flow management are not adequately considered... It is passenger flow management that should form 'the mortar that binds the evacuation analysis together' rather than the questionable assumption that successful evacuations only depend on the design of the mechanical provisions for evacuation... Undefined terms, such as similar cabin configuration, similar flight attendant duties, and equivalent test make the approach untenable... The proposed analytical procedure considers each element in isolation from the other elements, and does not provide adequate safeguards that the system performance will be demonstrated."

RESPONSE: The AFA characterization of the basic assumption upon which the analytical procedure of the draft AC is based fails to consider the requirements for test data that substantiate the evacuation capability of the airplane. Only through the application of such data can compliance with § 25.803 be shown. Neither the design requirements alone, nor only passenger management activities, can affirm the evacuation capability of the airplane. The "mortar" of the process is the applicant's ability to integrate all relevant data to form an accurate representation of the airplane's evacuation system capability and to present this model to the FAA. While the model represents a serialized (but not isolated) process, its tenability for any specific airplane will be the responsibility of the FAA to judge, and the combined requirements of paragraphs 7.b, 7.c, 7.e, 7.g, 7.i, 7.q, 7.r, and 7.s ensure an adequate basis to make such judgments.

ALPA:

COMMENT: "Specifically, it (the AC) presents specific guidelines for the use of data from emergency evacuation demonstrations of only vaguely related aircraft in the analytical approval process of a subject aircraft... Only vague references to 'appropriate tests', to provide 'sufficient data', with 'when appropriate' language... We do not support

the vague manner implied in the proposed analysis process... we have called for the analysis to be conservative (but) this has only been given lip service in this proposed AC... this proposed AC is vague and would not even lend itself to a validation process because it is not specific in regards to the process of determining applicability of the data and processing of the data."

RESPONSE: The terms "sufficient data, appropriate tests, and when appropriate" are, in fact, open to interpretation. However, while ALPA cites certain paragraphs to support their argument, these paragraphs fail to disclose the full range of context the AC provides. Other paragraphs -7.a, 7.b, 7.c(3), 7.d, 7.e, 7.i, 7.j, 7.k(1), 7.k(2), 7.k(4), and 7.m- all reference specific requirements that data must meet to be usable. Appropriate tests are defined in paragraphs 7.i, 7.j, and 7.k; these requirements are similarly specific. The analytical method to be applied is also not vague, as paragraphs 7.l, 7.m, 7.o, 7.p, 7.t, and 7.u describe the mathematical algorithm that must be applied and the success criteria that must be achieved to certificate any airplane through analysis. The conservatism required of the data and results (using arithmetic averages) used to support analysis is based on historical precedent and does not vary from current FAA practices. Validation of such results from the analytical process will depend not only on the specific sources and applicability of the data offered in support of an analysis (as required in the paragraphs cited above), but again depends on the demonstrated ability of the FAA to judge the worthiness of the applicant's analytical model. As the proposed analytical process is more specific and deterministic than previous guidance has required, statistical validity should improve relative to current certification requirements.

ACAP:

COMMENT: "Although the draft AC is intended to offer guidance on using analysis as a 'conservative prediction of the results that would be achieved if a full-scale demonstration were conducted' (Sect 7.a.1), it later strays from this goal, permitting plainly non-conservative estimators such as average evacuee flow rates. .. While the draft AC contains much good material, mostly on improving evacuation demonstration procedures, ACAP believes it also includes several significant threats to the interests of the traveling public, and therefore opposes its adoption."

RESPONSE: See the response about conservatism to the same comment voiced by ALPA above. Similarly, the application of the AC towards certification of any candidate airplane has been shown above to be the province of the FAA. While easily decried, potential threats to the traveling public are something taken seriously by the FAA, and for the FAA to allow such threats to materialize through misuse of the analytical process described in the AC is beyond the scope that this, or any other AC, could assure. However, the need for compliance with the many specific guidelines that have been included in this AC is designed to assist the FAA in assuring that any such misuse cannot occur. Unfortunately, the commenter did not identify what the significant threats were and, therefore, they cannot be specifically addressed.

IAPA:

COMMENT: "IAPA believes that using analysis in lieu of a full-scale demonstration is counterproductive to ensuring a safe as possible evacuation of the aircraft in an emergency situation. (although) We realize any demonstration has its limitations due to the difficulty in reproducing actual emergency conditions."

RESPONSE: The IAPA realizes the lack of correlation between demonstrations and actual emergency evacuations, but calls for them anyway. Actual full-scale evacuation demonstrations have a history of producing injuries themselves - thus, the attempt to produce an analytical equivalent. It is likely that a single full-scale demonstration could not provide the statistical confidence in evacuation system performance that could be derived from analysis of the average performance of passengers in multiple demonstrations of similar systems. It is the lack of such data that should drive full-scale evacuation demonstrations.

ADF:

COMMENT: "Appropriateness of analysis and the data used to complete the analysis appears to be subject to individual packaging and presentation and the willingness of the FAA Certificate Office making the decision. This appears to allow significant inconsistency from one case to the next... which overall could lead to less than the highest possible level of safety... Use of airline and (aircraft) manufacturers employees as permitted in past demonstrations, along with briefings provided to those participants, does not constitute a valid sample and the resultant data base may also lead to analysis that may not be valid"

RESPONSE: The specific requirements that the data and success criteria must meet to comply with the AC provide a level of rigor that has not been heretofore explicit. Such rigor should eliminate many of the concerns about inconsistency, although individual packaging and presentation of data will be required of the applicant(s). Only through such packaging can an applicant make its case for certification, but all applicants will probably not exhibit the same degree of sophistication in such endeavors. Utilization of company employees has similar specific limitations that attempt to eliminate potential biases in favor of the applicant; a similar case could be made about allowing frequent flyers to participate in evacuation demonstrations. However, elimination of such participants would deny that many airplane passengers have extensive flying histories and know much about airplanes. Only knowledge about the new model or configuration has been considered prejudicial.

IPA:

COMMENT: "The proposed AC, in my opinion, is too vague and would allow introduction of aircraft into revenue service without providing the protection the trusting public deserves...there should be a validation period where analytical and actual full scale demonstrations are done in parallel to verify the predicted performance of an aircraft's emergency systems and the passenger and crew interactions."

RESPONSE: The concerns about vagueness and statistical validity have been addressed above; the implication of analysis based on data derived from multiple demonstrations and airplane tests is for a greater degree of trust in the safety of airplanes. The area of passenger behavior is interesting, though, as the IPA makes it sound like one such demonstration of passenger behavior will somehow shed light on all the other passengers that might fly on the airplane. Passenger and crew interactions will depend on the specific individuals involved, and as stated above, it is an integral factor in evacuation demonstration outcomes. (Reference the single passenger in the B-777 full-scale demonstration.) Again, it is likely that data derived from multiple demonstrations of similar systems would provide greater confidence of evacuation system performance than a single full-scale demonstration would assure.

IBT:

COMMENT: "We are staunchly opposed to this AC which will, in effect, circumvent the public rulemaking process by permitting analysis for virtually all aircraft certifications in lieu of the presently required full-scale emergency evacuation demonstration... we do not accept the underlying promise of the proposed analytical method, i.e., that any aircraft configured so that each of the 'minimum' evacuation-related requirements of the FARs, considered individually, is met or exceeded will have satisfactory emergency evacuation performance and therefore does not require a full-scale emergency evacuation demonstration... the proposed analytical method does not include an accurate and reliable assessment of passenger flow management, nor other factors involving the interface of equipment, crew, and passengers which will impact evacuation."

RESPONSE: Inasmuch as this AC does not change any of the requirements for the evacuation demonstration as specified in the FARs, there is, in fact, no rulemaking involved. All other concerns have been addressed above.

FAA Action

FAA Action – Final rule FAA-2004-19629